Recitation 7 Worksheet

1. Describe how the process of lateral inhibition works in determining neuronal versus ectodermal cell fate. Include important genes as well as a detailed description of the signaling pathway involved in this process.

2. Describe how intrinsic signaling is involved in the formation of the invertebrate mechanosensory bristles. In particular, describe how this type of signaling leads to the formation of the neuronal cell, which protein is involved, and how its function leads to the formation of a neuron.

Answers:

1. The two sets of genes involved in this process are the proneural genes, which promote neurogenesis, and the neurogenic genes, which turn off proneural genes. Of the proneural genes, the Achaete-Scute complex (AS-C) is the most important, while the most important complex encoded by the neurogenic genes is Enhancer of split (Espl). The default cell fate is ectodermal, so proneuronal genes are usually turned off. The Notch/Delta pathway is involved in these cell fate decisions. One of the cells begins to express a little more of the delta ligand, which binds to its receptor Notch on the neighboring cells. This causes the cleavage of Notch by gamma-secretase, and allows the Notch intracellular domain to translocate into the nucleus, where it activates the transcription factor Suppressor of Hairless (Su(H)). This activates the transcription of Espl, a repressor complex which represses the transcription of proneural gene complex AS-C. Therefore, the cells in which Notch is active will not become neurons. In cells which are on the neurogenic pathway proneural genes are activated, and one of the targets is delta itself, establishing a feedforward loop where delta expression is amplified.

2. The invertebrate mechanosensory bristles are sensory organs that respond to chemical and mechanical stimuli and cover the insect's body. They are formed from the sensory mother cell, a stem cell that undergoes two asymmetric divisions to form four cells: a bristle cell, a socket cell, a neuron that innervates the bristle, and a glial cell. Numb is a protein that is involved in endocytosis, and it is tethered to the cytoskeleton on one side of the cell. With each cell division, numb is asymmetrically inherited and eventually ends up in the cell that will become a neuron. The function of numb is to endocytose Notch, leading to the expression of proneural genes, and the formation of a neuron (see above for a detailed description of the Notch/delta pathway).

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